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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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09/894,627

06/28/2001

John T. Boland

82531DMW

6130

7590

11/25/2005

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EXAMINER

TUCKER, WESLEY J

ART UNIT

PAPER NUMBER

2623

DATE MAILED: 11/25/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/894,627	Applicant(s) BOLAND ET AL.	
	Examiner Wes Tucker	Art Unit 2623	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 17 November 2005.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-17 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-17 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 18 October 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on November 17th, 2005 has been entered.

Response to Arguments

2. Applicant's amendment filed November 17th, 2005 has been entered and made of record.

3. Applicant has amended claims 1, 9 and 16. Claims 1-17 remain pending.

4. Applicant's arguments have been fully considered but they are not persuasive for at least the following reasons:

5. Applicant argues that the reference to Sachdeva does not disclose the newly amended features of a 3-dimensional intra-oral control target, capturing images from non-orthogonal capture positions reducing image errors due to distortion.

Applicant further argues that photogrammetry is clearly different from the single scaling

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factor used in Sachdeva. Applicant has amended the claims in an attempt to distinguish the presently claimed invention over the prior art of Sachdeva.

6. First with regard to the newly amended feature of a 3-dimensional control target, the targets in Figs. 2 and 3 read on this limitation because these targets are used to control a 3-dimensional model creation process namely the scaling of the model.

7. With regard to the newly added limitation of capturing a series of images from a plurality of non-orthogonal positions capture positions, the capture positions of Sachdeva are still interpreted to read on this limitation (column 5, lines 50-65 and column 6, lines 52-65). Sachdeva discloses capturing images from multiple locations and angles, but does not explicitly disclose them to be orthogonal. Sachdeva discloses side, front and bottom images are disclosed but does not suggest in any way that the angles are orthogonal. It appears that Applicant has amended the claims with this particular feature to distinguish from the prior art reference of Sachdeva. However it is also noted that it is not stated anywhere in the specification of the present application that the angles are non-orthogonal. It is further noted that capture positions, which are essentially points in space cannot be orthogonal or non-orthogonal as orthogonal is typically used to describe lines or vectors. This limitation is therefore viewed as both new matter and indefinite and is rejected below accordingly under 35 U.S.C. 112.

8. With regard to the newly added limitation of photogrammetrically adjusting the image parameters using the measurements of the control features. Sachdeva discloses adjusting the scale which is considered a parameter using the measurements of the control features (column 5, lines 1-11).

9. With regard to the newly added limitation of reducing image errors due to distortion and the variable orientations of the capture positions, there is no mention of distortion or anything that would explain the use of the word distortion in the specification of the present application. The addition of this feature is therefore interpreted as new matter and has been accordingly rejected below under 35 U.S.C. 112. In the Applicants remarks, reference is made to focal length and lens distortion parameters, however these features are not mentioned in the specification and are therefore deemed to be new matter.

10. Applicant further argues that photogrammetry is clearly different from the scale correction taught by Sachdeva. Applicant appears to base this statement on the details of the the ability to correct for sources of error beyond scale, such as distortion, however as stated above such features do not appear in the specification and are therefore inadmissible. Further Examiner points out that dictionary.com defines photogrammetry with two definitions as follows:

1. The process of making maps or scale drawings from photographs, especially aerial photographs.
2. The process of making precise measurements by means of photography.

The scaling correction and 3D modeling of Scahdeva is interpreted fairly as a practice of photogrammetry regardless of the techniques of photogrammetry disclosed in the cited photogrammetry textbook cited in the Applicant's present response. The rejection is therefore maintained as presented below.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

11. Claims 1, 9 and 16 rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. Claims 1, 9 and 16 all claim the new limitation of capturing a series of images from non-orthogonal capture positions. There is no mention or explanation in the specification that the capture positions are non-orthogonal or for that matter what is meant by non-orthogonal capture positions. See 35 U.S.C. 112, second paragraph rejection below.

Claim 1 is also rejected for including the new matter limitations of reducing image errors due to distortion because image errors due to distortion is not disclosed or suggested in the specification.

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

12. Claims 1, 9 and 16 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 1, 9 and 16 all include the limitation of capturing a series of images from a plurality of non-orthogonal capture positions. It is unclear how capture positions, which are essentially points in space, can be either orthogonal or non-orthogonal. Orthogonal typically means lying or intersecting at right angles or being perpendicular. Orthogonal is typically used to describe line segments or vectors having length and direction. Capture positions are merely coordinates and points in space and cannot be described as orthogonal.

Orthogonal has also been defined as statistically independent, which would mean that non-orthogonal means statistically dependent, but this definition doesn't seem to have any meaning in the present context either. Appropriate explanation and/or correction are required.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

13. Claims 1-4, 7-12, and 14-16 are rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent 6,512,994 to Sachdeva.

With regard to claim 1, Sachdeva discloses a method for creating a dental model from a series of images of an intra-oral object, said method comprising the steps of:

- a) capturing a series of images of an intra-oral object and a 3-dimensional control target from a plurality of non-orthogonal capture positions (column 5, lines 50-57), where the object includes common surface features wherein said control target is in close proximity to the object, and arranged with respect to the object to provide control features (column 4, lines 35-40);
- b) measuring the control features from the images of the control target and the object (column 4, lines 38-50);
- c) analytically generating a 3-dimensional model of the object by photogrammetrically adjusting the image parameters using measurements of the control

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features, thereby providing a photogrammetrically aligned 3-dimensional model of the object while reducing image errors due to the variable orientations of the capture positions (column 4, lines 40-45 and column 5, lines 35-60). Sachdeva discloses reducing the image errors due to the variable orientations are interpreted as the multiple x-ray scaling factors determined for multiple teeth as well as capturing images from multiple angles such as side front and bottom perspectives and

(d) adjusting the photogrammetrically aligned 3-dimensional model of the object by aligning the common features of the model to like features in the image of the object, thereby producing an aligned dental model from the series of images (column 5, lines 50-65).

With regard to claim 2, Sachdeva discloses the method as claimed in claim 1 wherein step (b) further includes the step of measuring the common features from the series of images of the object (column 5, lines 59-67). Here the common features are interpreted as the physical attributes on which reference points, which are measured, are to be placed.

With regard to claim 3, Sachdeva discloses the method as claimed in claim 1 wherein step (c) comprises the steps of:

performing a photogrammetric adjustment (column 4, lines 40-46); and

refining the photogrammetric adjustment by photogrammetrically projecting a 3-dimensional model of the target, determining misalignment of the control features and

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correcting the misalignment, thereby producing the photogrammetrically aligned 3-dimensional model of the object (column 4, lines 46-63 and column 5, lines 35-49, column 6, lines 52-67, column 8, lines 7-12). Here the first photogrammetric adjustment is interpreted as the scaling and the refinement is interpreted as the adjustment in the 3-D coordinate space pictured in figures 8 and 9.

With regard to claim 4, Sachdeva discloses the method as claimed in claim 1 wherein step (d) comprises the steps of:

determining misalignment of the common features in the photogrammetrically aligned 3-dimensional model relative to the images of the object by photogrammetrically projecting the model onto an image of the object (Fig. 9, element 100 and Fig. 8); and

applying a 3-dimensional morphing algorithm to correct for the misalignment (Fig. 8, element 82). Here Sachdeva discloses how the imaged reference points are used to determine misalignment, rotation, etc. of a tooth.

With regard to claim 7, Sachdeva discloses the method as claimed in claim 1 wherein the intra-oral object is one or more teeth (Figs. 2 and 3).

With regard to claim 8, Sachdeva discloses the method as claimed in claim 7 wherein the control target is positioned around said one or more teeth (Figs. 2 and 3).

With regard to claim 9, Sachdeva discloses a system for creating a dental model from a series of images of an intra-oral object, said system comprising:

a camera for capturing a series of images of an intra-oral object and a 3-dimensional control target from a plurality of non-orthogonal capture positions (column 5, lines 50-57), where the object includes common surface features wherein said control target is in close proximity to the object, and arranged with respect to the object to provide control features (Figs. 2 and 3);

photogrammetric means for measuring the control features from the images of the control target and the object (column 4, lines 37-54);

a digital processor including instructions for (a) analytically generating a 3-dimensional model of the object by photogrammetrically aligning the measurements of the control features, thereby providing a photogrammetrically aligned 3-dimensional model of the object while reducing image errors due to the variable orientations of the capture positions (column 4, lines 37-54 and column 5, lines 35-49); and (b) adjusting the photogrammetrically aligned 3-dimensional model of the object by aligning the common features of the model to like features in the images of the object, thereby producing an aligned dental model from the series of images (column 5, lines 50-57).

With regard to claim 10, Sachdeva discloses the system as claimed in claim 9 wherein said photogrammetric means further measures the common features from the series of images of the object (column 4, lines 35-40 and column 5, lines 50-57).

With regard to claim 11, Sachdeva discloses the system as claimed in claim 9 wherein said digital processor further includes instructions for performing a photogrammetric adjustment and refining the photogrammetric adjustment by photogrammetrically projecting a 3-dimensional model of the image, determining misalignment of the control features and correcting the misalignment, thereby producing the photogrammetrically aligned 3-dimensional model of the object (column 4, lines 46-63 and column 5, lines 35-49, column 6, lines 52-67, column 8, lines 7-12). Here the first photogrammetric adjustment is interpreted as the scaling and the refinement is interpreted as the adjustment in the 3-D coordinate space pictured in figures 8 and 9.

With regard to claim 12, Sachdeva discloses the system as claimed in claim 9 wherein said digital processor further includes instructions for determining misalignment of the common features in the photogrammetrically aligned 3-dimensional model relative to the images of the object by photogrammetrically projecting the model onto an image of the object and applying a 3-dimensional morphing algorithm to correct for the misalignment (Fig. 9, element 100 and Fig. 8, element 82).

With regard to claim 14, Sachdeva discloses the system as claimed in claim 9 wherein the intra-oral object is one or more teeth (Fig. 2).

With regard to claim 15, Sachdeva discloses the system as claimed in claim 14 wherein the control target is positioned around said one or more teeth (Fig. 2).

With regard to claim 16, Sachdeva discloses a method for creating a dental model from a series of images of one or more teeth, said method comprising the steps of:

(a) capturing a series of images of said one or more teeth and a 3-dimensional control target from a plurality of non-orthogonal capture positions (column 5, lines 50-55), where said one or more teeth include cusp and valley surface features (Figs. 4 and 5) describing their natural topographic surfaces and a rigid control target resting on said one or more teeth so as to provide control features (Figs. 2 and 3 and column 4, lines 35-45);

(b) measuring the control features from the images of the control target and said one or more teeth (column 4, lines 35-45);

(c) analytically generating a 3-dimensional model of said one or more teeth by photogrammetrically aligning the measurement of the control features, thereby providing a photogrammetrically aligned 3-dimensional model of said one or more teeth while reducing image errors due to the variable orientations of the capture positions (column 4, lines 37-54 and column 5, lines 35-49); and

(d) adjusting the photogrammetrically aligned 3-dimensional model of said one or more teeth by aligning the cusp and valley surface features of the model to like features in the images of said one or more teeth, thereby producing an aligned dental model from the series of images (column 5, lines 50-57 and Figs. 4 and 5). It is understood

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that all the features of the teeth including cusp and valley surfaces will line up when accurately matched.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

14. Claims 5, 6 and 13 rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,512,994 to Sachdeva in view of U.S. Patent 6,648,640 to Rubbert et al.

With regard to claim 5, Sachdeva discloses the method as claimed in claim 1, but does not explicitly disclose further comprising the step of using the aligned dental model to generate a dental restorative piece for the intra-oral object. Rubbert discloses a similar invention to that of Sachdeva in which 3-D model is generated with a CAD system (column 5, lines 60-63 and column 71) and is used to supply a 3-D model to a stereo lithography system that manufactures a plastic model of teeth (column 72, lines 26-29). Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to use the 3-D model generated by Sachdeva in combination with the

plastic teeth manufacturing taught by Rubbert in order to generate a 3-D schematic for a replacement plastic tooth.

With regard to claim 6, Sachdeva discloses the method as claimed in claim 1, but does not disclose further comprising the steps of providing a database of generic 3-dimensional models and utilizing a selected one of the generic models in step (d) in the alignment of the common features of the photogrammetrically aligned 3-dimensional model to like features on the image of the object. Sachdeva discloses finding alignment or reference points that do not change throughout the course of treatment (column 6, lines 1-22). Rubbert discloses three dimensional virtual template tooth objects (column 50, lines 38-40) for such purposes as in providing replacement teeth as they fit in a 3-D model. Therefore it would have been obvious to one of ordinary skill in the art at the time of invention to provide a data base of generic 3-D models in order to manipulate the models to see if a replacement tooth might fit in a patients mouth.

With regard to claim 13, the discussion of claim 5 applies.

15. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,512,994 to Sachdeva.

With regard to claim 17, Sachdeva discloses the method as claimed in claim 16 wherein the control features comprise vertices (column 8, lines 8-12) and discloses a

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rigid target (Fig. 2), but does not disclose wherein the rigid control target has a saddle form resting over said one or more teeth and the control features comprise vertices in the saddle form. However it would have been obvious to one of ordinary skill in the art at the time of invention to place any kind of rigid target on or around or on top of the tooth as a matter of design choice to give optimum or most appropriate scanning results.

Conclusion

16. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Wes Tucker whose telephone number is 571-272-7427. The examiner can normally be reached on 9AM-5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Jingge Wu can be reached on 571-272-7429. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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Wes Tucker

11-22-05

A handwritten signature in black ink, appearing to read 'Vikram Bali', with a large, stylized initial 'V' and a long, sweeping horizontal stroke at the end.

VIKKRAM BALI
PRIMARY EXAMINER